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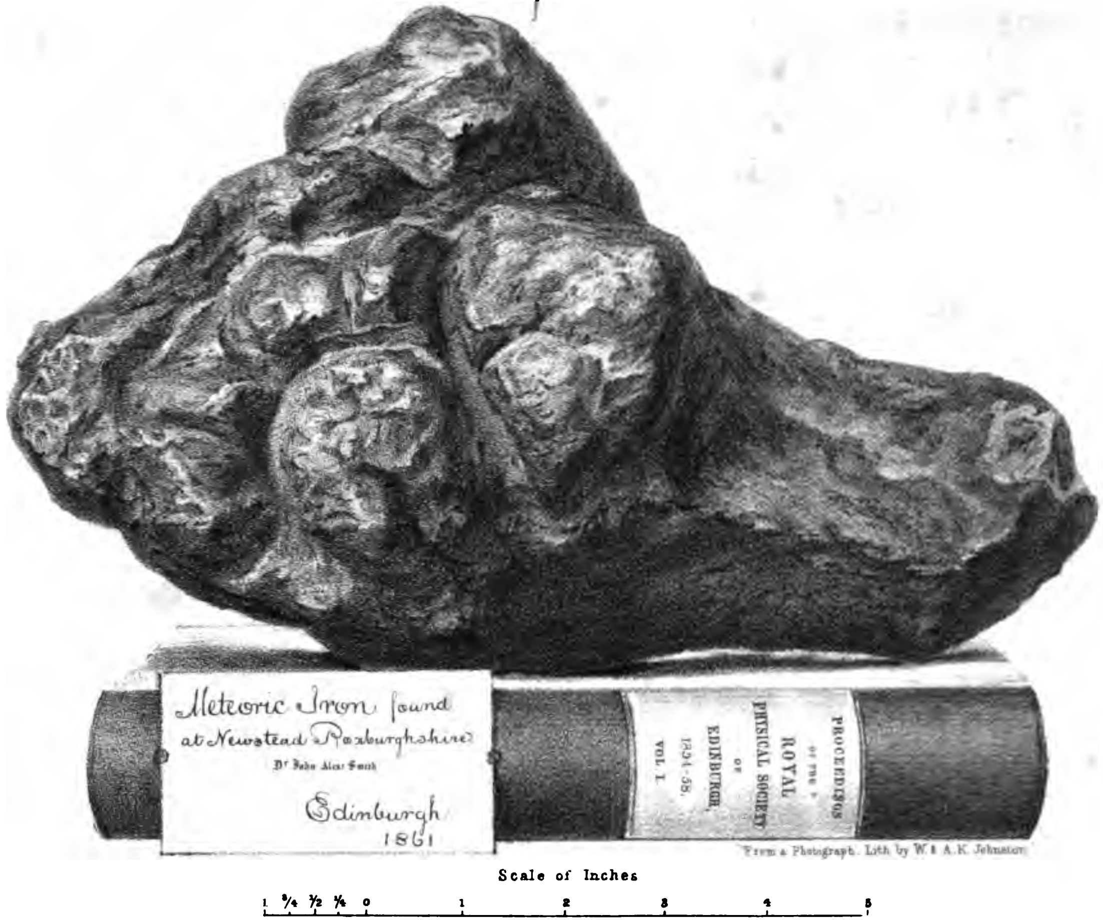

From a Photograph. Lith by W. & A. K. Johnston

NOTICE

OF A

MASS OF METEORIC IRON,

FOUND IN THE

VILLAGE OF NEWSTEAD, ROXBURGHSHIRE;

WITH SOME

GENERAL REMARKS ON METEORITES.

BY

JOHN ALEXANDER SMITH, M.D.;

AND

CHEMICAL ANALYSIS OF THE METEORIC IRON.

BY

MURRAY THOMSON, M.D.

From the Edinburgh New Philosophical Journal, New Series, for July 1862.

EDINBURGH:
PRINTED BY NEILL AND COMPANY.

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NOTICE OF METEORIC IRON, &c.*

Description of Mass of Iron.—The external surface of this mass of iron (exhibited to the meeting) is rough and irregular; and it affects the magnetic needle very strongly.

Its shape and general appearance is rather elegant, consisting principally of a large rounded and lobulated mass, irregular in outline, which tapers rapidly at one end to a four-sided pyramidal extremity, and terminates in an obliquely truncated point. (See Plate.)

For the purpose of a detailed description of its form, it may be divided into two portions: the larger extremity, which is rounded in its character; and the smaller, flattened, and smoother on its surface, which tapers to a blunt point. The first, or larger portion, is formed of a clustering mass of rounded lobes irregularly grouped together, and terminates behind in a broad blunt edge. The lobes vary in size, and in their greater or less projection from its surface. A deep furrow runs obliquely round the whole mass, and in front of it (towards the pointed extremity) there rises a large, round, and prominent lobe, with a smaller lobe on one side, and two, more irregularly shaped, projecting masses on the other; by measuring round these masses you get its greatest circumference. The second, or smaller portion of the meteorite, lies immediately in front of the prominent lobes just described, its rounded outlines rapidly changing into four irregular smoother surfaces or planes, which, meeting one another with two acute and two obtuse angles, together form a somewhat pyramidal four-sided figure, which tapers rapidly towards this end of the mass, and terminates in an irregular quadrilateral or lozenge-shaped extremity. The sides of this lozenge measure each about 2½ inches in length; and one of these sides (showing a dimpled outline), from the oblique position of this lozenge-shaped extremity to the general mass of the meteorite, forms its small terminal edge, or pointed extremity.

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* Read before the Royal Physical Society of Edinburgh, April 23, 1862.

The whole shape of this piece of meteoric iron suggests the idea, that when its fall took place, the extremity, now the smaller and more pointed, first reached the earth, which, from its resistance, crushed the glowing and softened mass into these peculiarly flattened surfaces of its pyramidal extremity, bending even the oblique point itself, a little upwards and backwards; while the larger extremity, though slightly flattened below, where it struck the ground, still shows in the projecting masses of its upper surface, the part least affected by the shock of its terrible descent through our atmosphere, to bury itself in *terra firma.*

Size.—The mass of iron measures 10¾ inches in its greatest length, and 7 inches across the widest part, about the middle of its length; the larger blunt-edged extremity measuring 6 inches across. Its circumference round the larger extremity is 1 foot 3 inches; round the large lobular projection (about the middle of the mass) its widest part, 1 foot 8½ inches; while within 1½ inches of the point, it measures only 9½ inches in circumference.

Weight.—It weighed 32 lbs. 11 ounces 1½ drachms, avoirdupois, equal to 39·60 lbs. troy.

Specific Gravity.—The specific gravity of the entire mass, Dr Murray Thomson informs me, is 6·517.

Colour.—The external surface of this meteoric iron is of a dark reddish brown, approaching in some parts to black; and the lobulated parts show here and there, especially in the furrows which divide them, spots of a brighter red colour, due apparently to the partial oxidation of its surface.

Photographs.—The general appearance of the meteorite is well shown in the photographs exhibited. These have been beautifully taken by Mr Alexander M'Coll. The mass of metal was laid on the 8vo vol. of the Royal Physical

Society's Proceedings, which thus gives a correct idea of its relative size and proportions; and, when the second picture was taken, the volume was turned quite round, without touching the iron; and in this way an exact representation of both its sides was obtained. From one of these photographs the accompanying Plate of the meteorite is taken.

Plaster Casts.—For the purpose of preserving completely the original appearance of the meteorite, a mould was carefully taken before it was sent to the lapidary to be cut. This has been very successfully done, as shown by the casts* exhibited, coloured after the original.

Rarity.—This mass of meteoric iron is the largest that has yet been discovered in Great Britain; only *one* other indeed, is known, a very small one—about the size of a hazel-nut. Robert Philips Greg, Esq., of Manchester, in his recently published valuable work,† and in letters with which he has favoured me, states that this small mass of meteoric iron "was found a good many years back by Da Costa, at Leadhills, and is now in Mr Greg's collection." It has since been secured for the national collection, the British Museum. Mr Greg tells us the proportion of meteoric stone to iron-falls may be taken at 25 to 1,—*i. e.*, 96 per cent. of all that fall consist of stony matter; and in his Mineralogy he gives a list of nineteen or twenty meteoric *stones*, the fall of which has been recorded, as occurring in Great Britain and Ireland. The instance above referred to is, however, the only one of meteoric *iron* previously known and recorded. In the neighbouring country of France one specimen has been observed; and Mr Greg gives twenty-seven instances of meteoric irons found in the old world.

History of the Discovery of the Meteoric Iron.—The ancient village of Newstead, where this mass of iron was found many years ago, lies at the eastern extremity of the valley of Melrose, its cottages rising gradually up the bank, towards the higher ground beyond, which was probably the site, as I have formerly pointed out, of the Roman town of Trimontium.* Having already referred to this neighbourhood when various relics of the Roman occupation, discovered here, were presented to the Museum of the Society of Antiquaries of Scotland, I shall now simply point out the exact locality where this mass of meteoric iron was discovered. Like other Scottish villages which have not been interfered with in their formation by the over-ruling taste of some adjoining great landowner, the dwellings of the little proprietors or feuars have been scattered over the ground as their own fancy or convenience dictated,—keeping, however, in a general way by the lines of the roads which intersect the village, and clustering especially along the principal highway which passes through, running east and west, from Drygrange Bridge towards Melrose. On the south side of this last mentioned road, and near the eastern termination of the village, there is a group of three cottages, beyond which a narrow cross road turns southwards into the valley behind, past one of the village wells, and crosses the little streamlet which runs at the bottom of the cottage gardens.

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* Mr Alexander Stewart, 1 Surgeon Square, will be glad to supply casts, at a very moderate price, to any one who may wish to possess an exact *fac simile* of this rare specimen of a Scottish meteoric iron.

† A Manual of the Mineralogy of Great Britain and Ireland. By R. P. Greg and W. G. Letsom. London: 1858.

In the year 1827, Mrs Kate Williamson or Davidson, the proprietor of the third cottage from the cross road just referred to, commenced to build another small cottage along the western border of her garden, to which there was access past the open end of her house, forming as it did the farthest west of the little group of cottages. The house was to be erected behind the other cottages and at right angles to them, and, to save the garden ground as much as possible, it was to be placed along its boundary. The garden was enclosed by a broad mound of earth or old turf wall with some stones intermixed; this, of course, had to be removed, and the ground brought somewhat to a level surface before the foundations of the house could be dug; these were then cut out of the firm undisturbed clay below, and the building operations commenced. Mrs Davidson had her own peculiar ideas of what were to be the special conveniences of her new cottage, and, accordingly, she caused two small pits or cellars to be dug in the floor of the kitchen, at no great distance from the back wall and fireplace, which were to be covered over with wooden lids or doors, and in them coals or other necessary articles were intended to be kept. Curious enough, it was in the process of digging out one of these sunken cellars that the black extremity of this piece of meteoric iron was noticed sticking in the clay, at a depth of some three or four feet from the floor of the house. These pits were dug out of the ground, close by the boundary of the garden, on that part of it formerly covered by the broad mound of earth, or old turf wall, which formed the original fence. (The site of this house is well seen in the Ordnance Survey Map of the village, in the small division No. 2211.)

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* See Trans., vol. iv., and Proc. Soc. Ant. Scot. vol. i. &c.

The unusual appearance and great weight of the black-looking stone attracted the attention of Mr George Burnet, one of the masons employed at the work; and as he had a taste for collecting anything peculiar, he carried it to his own cottage, which was only a few doors farther down the village. Mr George Burnet died in 1842, and Francis his brother succeeded to the cottage and garden, which he still occupies. Some time after a stone wall was built round this cottage garden, and as specimens of different kinds had been collected, an old stone trough, which happened to be in the way, was laid on its side and built into the wall, forming thus a sunk recess, where those various specimens which were considered scarcely ornamental enough to be kept in the dwelling house, could be placed in safety; and here this mass of meteoric iron has lain, for five-and-thirty years; exhibited from time to time, with the other curiosities, to any chance visitor whose fancy might lead him to examine them.

Francis Burnet is an intelligent, observing man, and to him I was formerly indebted for collecting some of the Roman relics which were found in the neighbouring fields. When residing in the district last summer, I visited the village, to learn if anything new, or rather old, had been observed in the course of the agricultural operations of the last few years; and my attention was soon attracted to the small collection of specimens in Mr Burnet's garden. I was at once struck with the very peculiar appearance of this mass of metal, which we removed to the burn side at the foot of the garden, to get washed and inspected more carefully. I then learned the history of its discovery, already so minutely detailed, and afterwards inspected the locality itself, being anxious to collect and put on record all the incidents relating to this specimen, which I was inclined to think might turn out to be a mass of Meteoric Iron. A hammer was got, and one of its corners was slightly abraded; this showed the pure metal of which it seemed to be composed; and its great weight, as compared with its size, proved that it must consist almost entirely of metal; it was therefore no ore of iron. While its peculiar shape was totally unlike that of any kind of manufactured metal—for its hardness, and closeness of grain, suggested that it resembled hammered iron, or steel; the district however, was no iron-producing one, and forges of greater size than that of the village blacksmith were quite unknown, and its history pointed to a period probably long before historic times. I was therefore convinced the specimen was native iron; and from the very great rarity of this metal in any quantity, and the fact of its being found buried in the clay bank, there appeared to be little doubt it was of meteoric origin. Stating my conclusions to Mr Burnet, and my anxiety to get possession of the iron for a more careful and decisive examination, he kindly agreed to let me have it for this purpose. Accordingly, it was arranged it should be immediately forwarded to my residence, that I might take it with me on my return to Edinburgh, for a complete determination of its true character and peculiarities. On mentioning to Mr Burnet my astonishment that no person had ever called attention to this very singular-looking piece of metal, the true character of which had been so long overlooked, I was informed that, some three or four years before, the Rev. Dr Rogers of Stirling, when on a visit to Newstead in search of Roman remains, among other things had examined it, and seemed to take a somewhat similar view to mine of its origin; but nothing having been said or done to settle the apparently very doubtful question, Mr Burnet had thought no more about the matter.

On bringing the mass to Edinburgh, it was shown to various friends, who at once agreed with me there was little doubt of its meteoric character. With Mr Alexander Bryson and Dr M'Bain's kind assistance, an abrasion was made on its surface, and the nitric acid test applied, when a slight appearance of the peculiar and characteristic etching became manifest; a little of the metal was then filed off, and put into the hands of Dr Murray Thomson, lecturer on Chemistry, without letting him know its history, and he informed me the filings consisted of iron, with a proportion of nickel. Native iron of terrestrial origin being almost chemically pure, and never containing any proportion of nickel, the mass of iron was therefore of meteoric origin, being an alloy of iron and nickel; the latter generally existing in very small proportion to the former.

The peculiar shape and appearance of this mass of metal itself, so entirely unlike any handiwork of man, was indeed almost proof enough to many of its meteoric character, of which, however, there was now no room for doubt.

The subsequent steps taken to learn the special peculiarities of its structure and chemical analysis have now to be detailed.

Section of Meteoric Iron.—The iron was cut longitudinally into two portions, by Mr Young, lapidary, as I was anxious to see whether any difference of structure existed in any part of the mass, or whether cavities containing olivine could be detected. Nothing of this kind, however, was disclosed, the mass being equally solid, dense, and steel-like in its appearance throughout, and the colour beautifully bright and white, like steel. With a new steel file, and Mr Alexander Bryson's assistance, I next proceeded to rub down as much of the surface of one of the pieces, as would suffice for a minutely detailed chemical analysis being made; and in assisting to do so, soon made a practical discovery of the extreme hardness or toughness of the metal, which in a comparatively short time turned the sharp points on the file itself. The hands soon became much blackened by the operation, as if plumbago was mixed with the iron. There seemed no doubt the metal was steel, from the carbon which was so manifestly present. The surface of the mass varied somewhat in its resistance to the file; its prism-like point was very close and hard externally, and contained apparently more of the blackening part of the iron; the upper and rounded portions were also harder and denser, at least externally, offering more resistance to the file. The tool seemed also to have less effect upon the iron when it was used across the mass, than in its longest diameter. Its hardness, as shown by a graving tool, was greatest next its outer surface—the inner portions being apparently softer, and more open in texture, while the prism-like point was tougher before the tool, and more like hammered iron; the explanation probably being—that this peculiarity was due to the shock of its fall being given principally to this part of the mass; and also, from its being suddenly cooled by the contact of its surface with the earth in which it was found buried.

The filings, of which about a troy ounce were procured, were black, and showed little of the shining metallic appearance of pure iron.

Chemical Analysis.—The filings were sent for examination to Dr Murray Thomson, who gives details of their composition in his subsequent communication. (See Analysis of Meteorolite, by Dr Murray Thomson.)

Test of Etching by Acid.—Each portion of the iron has been partially etched with the acid used by engravers on steel, which consists of equal parts of nitric and acetic acids; and the etched surfaces show the rough, irregular, projecting lines of the crystalline structure of the mass, which have been apparently but slightly acted on by the acid, from the presence of nickel; the dark lines and spaces showing where the acid has acted with greater effect. The acid was applied in the usual way for etching, and appeared to bite all at once, and that pretty deeply; it was then removed, the surface of the metal washed, and the acid reapplied, when it acted very slightly, and soon ceased to act altogether, not biting any deeper into the surface of the metal. The rough etched surface is characteristic of meteoric iron, various bright lines or points being observed in the fine frosted like appearance of the crystalline or fibrous surface of the metal. This etched surface is finer and more minute in its texture than that of any meteoric irons, the etchings of which I have been able to examine, suggesting a more minute subdivision of the particles of the iron and nickel, and a more general mixture of the nickel through the mass.*

A steel-plate, treated in exactly a similar manner as this meteoric iron, was exhibited, and showed simply a regularly depressed smooth portion where the acid had been applied.

These etched patches, having been placed near the middle of each surface of the two portions of the meteorite, perhaps rather unfortunately, give to a careless observer the idea of the mass having a core or central part of a different structure; this appearance is of course due entirely to the action of the acid.

Printed Impression from Etched Surface.—I was anxious to learn if it would be possible to get a cast or squeeze in wax, taken from the etched surface, on each of the two portions into which the mass was cut, that it might be electrotyped, and the electrotype cast (which thus exactly corresponds to the original surface of the iron) backed up with metal in the usual way, so that impressions might be printed from it. The cast taken from the larger patch of etching was so large, and the raised markings so slightly defined in their character, that, when it was used as a woodcut, the printer could not prevent it getting blotted all over, when attempting to take an impression from its surface. The smaller etched patch, from its less size, and possibly slightly more defined markings, was found to answer better, and an impression of it is accordingly exhibited, which gives a *fac simile* of the etched surface and structure of the metal.

The cast has been printed from, in the same manner as a woodcut, and shows the projecting parts black, the light spaces between being the more deeply etched parts of the surface, and the smooth polished metal surrounding the whole, appearing like a black border. The white spots which cross the picture show traces of the decay and line of the fracture, by which the mass became separated into two portions; for I was rather startled to learn that the process of taking the wax squeeze from the surface of the smaller half of the meteorite with the ordinary printer's press, had broken it in two. It was evident, however, from the fractured surface, which was simply a weathered looking or oxidised continuation of the deep furrow which partially surrounded the mass, that this furrow had penetrated much deeper than was suspected, and that the few scattered dark spots, like corrosions on the polished surface of the sections, were the termination of the inner portions of this very furrow, part of the decay of which might be caused by the exposure and weathering the mass had undergone, in the five-and-thirty years of its existence on the surface of the earth; the origin of the furrow being due to the lobulated arrangement of the mass.

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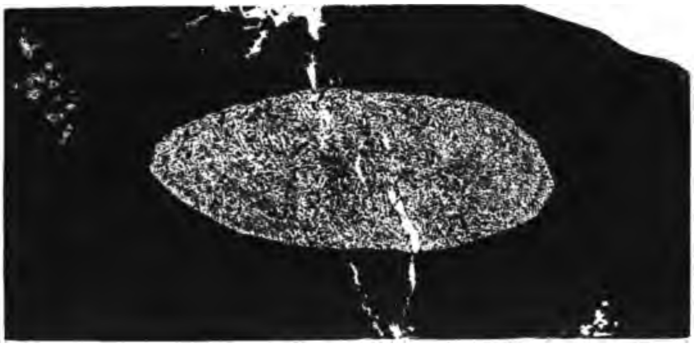
* Mr R. P. Greg of Manchester informs me this minute texture resembles the structure of the iron also found in Britain, and described by him, more than any other meteoric iron known; only the minute markings of his specimen appeared to be more angular and sharp in character.



Impression of Etched Surface of the Meteoric Iron.

Weight of each of the Sections of the Meteorite.—Dr Murray Thomson has furnished me with the following notes of the weight and specific gravity of the two portions of the meteorite:—

" Of the two pieces, one was lighter than the other and weighs :—

In air,	13 lbs.	4 oz.	10 drs.	(Avoir.)
In water,	11 „	3 „	13½ „	„

The larger and heavier mass weighs :—

In air,	18 lbs.	3 oz.	12 drs.	(Avoir.)
In water,	15 „	6 „	1 „	„

The specific gravity of the first is therefore	6·360
and of the second, . . .	6·385

"It is strange that neither of them should quite come up to the specific gravity of the mass when it was whole, which was, as formerly stated, . . . 6·517"

The difference in the specific gravity of these two portions may be explained, it seems to me, by the presence, in the smaller portion of the mass, of this large furrow, filled up with earthy-looking matter[*] of lighter specific gravity.

In conclusion, I may add a few notes on the general subject of Meteorites or Aërolites.

Theories of the Source or Origin of Aërolites.—Various theories have been at different times brought forward to account for the presence of aërolites, these strange and apparently accidental visitors.

These theories may be arranged in two great divisions:—

First, The terrestrial sources—the source or origin of these bodies being supposed to belong to our earth; and, *secondly*, The cosmical sources, which derive their origin from beyond our earth. These again may be each subdivided into two sections, or classes:—

I. TERRESTRIAL SOURCES.
  1. *Volcanic*—from the volcanoes of the earth.
  2. *Atmospheric*—from their supposed formation in the atmosphere of our earth.

II. COSMICAL SOURCES.
  1. *Lunar Volcanic*—from the volcanoes of the moon.
  2. *Interplanetary Space*—the planetary or asteroidal theory.

I shall not enter here into the arguments that have been brought forward both for and against these various theories, merely remarking that the old idea of their terrestrial origin is now almost entirely given up. The second of these divisions, and in particular that which derives their origin from a supposed belt of planetoids or asteroids revolving in space on the borders, or just beyond the most distant part (from the sun) of the earth's orbit, being now generally considered as the view which meets and explains most easily the peculiarities of their structure and appearance; I need only refer to the well-known memoirs on these subjects of Professors C. U. Shepard and J. L. Smith, M.D., of America,* and especially of Mr Robert Philip Greg† of Manchester. M. Haidinger, director-general of the Geological Survey of Austria, has also published his views on the origin of aërolites, in a recent communication to the French Academy of Science.

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[*] Dr Thomson afterwards examined some of this earthy-looking matter, and found it to consist of the same chemical components as the rest of the mass, the iron, however, being in the state of an oxide.

Catalogues of Meteors and Meteorolites.—Catalogues detailing the particulars of all known meteors, aërolites, &c., have been from time to time published. I may refer to those given in the Reports of the British Association, and to the very complete list by Mr R. P. Greg in the Report of the year 1860.

Aërolites may be supposed to have fallen on our earth from the earliest periods of its history. I am not aware, however, of any instances that have been noticed connecting their existence with the earlier or geologic history of our globe. In the sacred Scriptures, such expressions as the *great stones*, and the hailstones, that were cast down from heaven, on the enemies of Israel, on the memorable occasion when an apparent interruption of the earth's motion took place (Joshua x. 11); and, again, the use of such terms, as *coals of fire*, in addition to the lightning, by the Psalmist, when speaking of the wonders of the Almighty (Ps. xviii. 12, 13), suggest, at least, the possibility of an allusion to these mysterious bodies at that early period.

Meteoric Stones worshipped.—In the book of Acts (xix. 35) we have reference made to the image of the Diana of Ephesus, which fell down from Jupiter, undoubtedly an aërolite. The fall of one of these bodies among an ignorant and superstitious people, with its attendant phenomena of fire and explosion, would naturally be considered as a message from the gods, and especially from the presiding deity of the district. Various instances of falls of this kind are noticed by ancient authors, whose statements we have no reason altogether to disbelieve. We have also instances of the fall of aërolites recorded in our own day being followed by similar results, as in a case noticed by the Rev. Baden Powell, M.A.,

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* American Journal of Science.

† Essay on Meteors.

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&c., in his Report on Meteors to the British Association in 1859; of a stone-fall at Dooralla, near Loodianah, in 1815, when the natives worshipped it, and commenced subscriptions for erecting a temple over it. Two stones fell at Parnallee, near Madras, in 1857; and their fall was followed by exactly the same results—crowds of natives worshipping the larger stone, "as the image of their deity, which had fallen from heaven" (see Silliman's American Journal of Science, No. 32, Nov. 1861). One of these stones weighs 130 lbs., and is the largest meteoric stone known; it is now, I am glad to say, deposited in the British Museum.

There seems little doubt that meteoric falls were one, at least, of the causes of the stone-worship of the ancients, instances of which are represented on their coins, under canopies or shrines. The Diana of Ephesus is not represented in this way, although on an ancient medallion given as an illustration to a learned paper on the Coins of Ephesus, by Mr J. Y. Akerman, and struck, he supposes, for those who came to wonder and to worship at her shrine, there is a rude mummy-like figure of the goddess, and on its head, if not simply an imperfect *modius*, with which she is often represented, something which reminds one of the very distinctive shape of a meteoric stone or aërolite (Numismatic Chronicle, vol. iv. 1841, p. 118).

Mr Akerman, in a paper on the Stone-Worship of the Ancients, illustrated by their Coins (Numismatic Journal, vol. ii. 1837–8), since pointed out to me by Mr G. Sim, also refers to the probability of aërolites being objects of worship.

Map of Meteoric Stone and Iron Falls.—The illustration of the subject of aërolites would be increased if, in addition to these published catalogues, we had also a map showing their fall over all the world. I would be especially anxious, in a map of this kind, that a careful distinction be made (by colour or otherwise) between metallic, and earthy or stone falls; a distinction which, it appears to me, has scarcely been kept sufficiently in view by some writers, when considering the question of the distribution of aërolites. Had we such a map, we could judge at a glance whether meteoric falls were generally pretty uniform in their distribution over the earth, according to Mr Greg; or whether there are any signs of the local aggregation of these bodies in particular districts, as in the two so-called meteoric zones of Professor Shepard.

Have Meteoric Falls any relation to Terrestrial Magnetism?—We already possess maps, giving us the rain-fall over the world; and what a pleasure it is, when studying them, to be able to turn to other maps of allied phenomena, as, for example, the map of the winds, and to see at once how these different agencies act and react upon each other, and how the one map helps to explain to us the other. If we had our map of the aërolite falls, could we turn to any other map in our physical atlas that would help us to understand them any better? I cannot tell—but would be greatly interested in examining and comparing with it the maps illustrating the difficult subject of our terrestrial magnetism, and would be anxious to see whether the one threw any light, or appearance of light, at all on the other. To enable me the better to judge of this, I would carefully distinguish all *metallic* from *earthy* meteoric falls, and would be curious to observe whether the apparently irregular scattering of the former over the world could be seen to bear any particular relation to the various centres of greater magnetic force.

There are four poles or maxima of magnetic attraction known to exist in our earth, a stronger and a weaker, in the northern hemisphere; and also a stronger and a weaker pole in the southern hemisphere. Supposing I have correctly stated these views of our terrestrial magnetism, it does seem interesting to find an observer like Professor Shepard coming to the conclusion, from entirely different data, of the existence of the two meteoric zones, which at once attract me, by their position appearing to bear some relation to these northern poles of magnetic force. He tells us, he finds the meteoric zone of the old continent rather strangely translated farther to the north than that of the American continent; this seems also to show a relation between terrestrial magnetism and these meteoric falls, as it is stated that the northern pole of magnetic force of the Old World (the weaker of the two), lies a good many degrees farther north than that of the New World.

Another fact, which is rather a puzzling one, is the very great relative proportion of *metallic* falls which have been discovered in America, as compared with any other part of the known world—thirty-two meteoric irons having been found in the United States, according to Professor Shepard, twenty-three of which are included in his meteoric zone. While only fourteen meteoric irons (whose time of fall is unknown) have been recorded as found in the Old World, and eleven of these falls are included in its so-called meteoric zone.* Mr Greg gives the number of localities of meteoric irons in the Western Hemisphere as fifty-seven; those of the Eastern Hemisphere being twenty-seven.† Various explanations have been given of these facts; it is rather curious, however, to observe, that in the New World, we have the greatest number of metallic falls, apparently in the neighbourhood of the very locality where the magnetic force is described as being in a maximum in the northern hemisphere. The metallic falls of the Old World seem also to bear a relation to the other northern magnetic pole; though, from its force of attraction being relatively weaker, it may be, the number of these metallic aërolites here is less, and the concentration of them together would also appear to be less; the meteorites straggling, in their deposition, to greater distances from its centre, and so adding to the apparent length of this so-called meteoric zone. Can these various circumstances be dependent simply on an accidental coincidence? or do they not, at least at first sight, suggest the idea that this strange agent of magnetism has really something to do with these peculiar arrangements?

Writers on terrestrial magnetism tell us, as one of the ascertained results of their labours, that the agents of the greater part of the magnetic force of the earth are situated exclusively in the interior of the earth, although minor magnetic oscillations and influences on its surface are due, without doubt, to the direct magnetic influence of the sun and moon; still these are only minor influences, the great magnetic force of the earth being situated exclusively in itself. Now, in my ignorance mayhap of the question, it does not seem to me to

* American Journal of Science, 1850.

† Essay on Meteors, 1855.

be a thing past belief, that when the earth in its orbit comes into the neighbourhood of the region in which these aërolites are now believed to exist; and, when their occasional proximity is close enough to bring the attractive powers of the earth—the greater mass, to overbear that of the smaller—the aërolite; besides, the mere attractive force of gravity dragging it down to the earth, that mysterious agency, the earth's magnetic attraction, should also come into operation; and, that a greater influence should of course be exerted over those bodies which are purely metallic, the component parts of which being also magnetic, are all strongly acted on by this magnetic influence; so that, as the daily revolution of our world takes place, the metallic meteoric falls would especially occur, as near as possible, to the poles of the greatest magnetic force; or at least as near as would be compatible with the power of the other forces which might assist in attracting them to the surface of the earth. The possible, shall I say probable, result being, that *metallic* meteorites, other things being equal, would be found clustering in greatest numbers near the points of the earth's greatest magnetic force, at the time of their fall; and, the stony meteorites, attracted magnetically in a less degree, would, from the more general causes of their attraction, be spread more abroad over the general surface of the globe.

Of course the poles or points where the magnetic force is in a maximum state, in the southern hemisphere, would also have their share of these metallic masses; but with these regions we are comparatively unacquainted, and must not forget the greater presence of water—the sea—in this part of the world, which hides at once any meteoric fall that might take place on its surface. Metallic meteorites, however, are not altogether unknown in Australia, two very large masses* having recently been discovered within some twenty miles of Melbourne. A friend of mine, just returned from Melbourne, tells me he has seen portions of them, and they somewhat resemble the piece of iron I have exhibited.

Whether there may be any truth in these theories or not, I cannot determine, only they make me the more anxious that we should be possessed of a map of reference of these strange phenomena; and I hope our townsman, Mr Alexander Keith Johnston, will be good enough to give my hint of a map of the "Distribution of Aërolites over the Surface of the Earth"* his favourable consideration, when preparing for publication a new edition of his valuable national work, the "Atlas of Physical Phenomena."

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* One at least of these masses has been lately secured for the British Museum.

Analysis of the Meteorolite described in the foregoing paper by Dr J. A. Smith. By MURRAY THOMSON, M.D., F.C S., Lecturer on Chemistry.†

In giving a chemical description of this remarkable mass of meteoric iron, I have to call attention, in the first place, to its specific gravity; the process of taking which was first performed on the undivided meteorite, and afterwards on each of its halves. Of course, with such a weighty mass this process could not be done by means of the ordinary delicate balance. I had therefore recourse to the standard beams and weights contained in the office of the Inspector of Weights and Measures at the County Hall, Edinburgh. The weight in air of the whole mass was 32 lbs., 11 oz., 1½ drs., avoirdupois, equal to 39·60 lbs. Troy weight. The weight in water was 27 lbs., 10 oz., 13½ drs. This gives a specific gravity, it will be seen, of 6·517, which is very low for meteoric iron. It stands at the lowest limit of recorded specific gravities of other meteoric irons. Shepard (Silliman's American Journal of Science, vol. ii. New Series, p. 377) gives the specific gravities of iron and nickel meteorolites as ranging from 6·5 to 8·00. After the mass had been divided, the specific gravity was taken in a similar manner to the above, and the heaviest and most solid half gave a specific gravity of 6·385; that of the lightest, 6·360. The analysis was made on some filings of the mass obtained after polishing the surfaces of the halves. I should have preferred for this purpose a sample derived from various parts of the mass, but this, it would appear, was not easy to obtain without endangering the good appearance of the meteorolite.

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* Mr Greg of Manchester has since informed me that a map of meteoric falls has been published in Germany; he does not, however, state whether the author has made a point of distinguishing the *metallic* from the other meteoric falls.

† Read before the Royal Physical Society, April 23, 1862.

There is no point in the analysis calling for special description, except, perhaps, the determination of the nickel. This metal was estimated by dissolving a known weight of the meteorolite in hydrochloric acid, and after separation of the gangue of carbon and silica, the iron was peroxodized by heating with nitric acid, and then the iron oxide was precipitated by carbonate of baryta, and the excess of baryta afterwards removed by sulphuric acid. The precipitate of sulphate of baryta was removed by filtration, and the filtrate presented a decided green colour, which on concentration was deepened, showing the amount of nickel it contained to be considerable. The nickel in this solution was then precipitated and weighed as oxide. To arrive at a good result, it was necessary to operate on as much as 60 or 70 grains of the meteorolite. In the course of this process other metals, such as manganese, chromium, cobalt, &c., were carefully sought for, but no trace of them could be discovered. The qualitative analysis, therefore, showed the presence of iron, nickel, carbon, and silica; and these are present in the following proportions per cent.:—

Iron,	93.51.
Nickel,	4·86.
Silica,	0·91.
Carbon,	0·59.
	99·87.

It will be seen, therefore, that its composition is very simple, and not unlike that recorded in the analyses of other observers.

It may be remarked, in conclusion, that the occurrence of nickel in it, in such marked quantity, sets at rest any question that might be raised as to its meteoric origin. Though one or two pieces of undoubted meteoric iron exist without any nickel in their composition, yet that metal is held by Shepard (*vide* Silliman's Journal, *ut sup.*) to be the second most frequently occurring constituent.

Since the above was in print, I have again gone carefully over the determination of the weights and specific gravities of the portions of this meteorolite. In both of these I obtained trifling differences; but I need not here record the absolute weights, as the differences obtained are fully accounted for by another balance and set of weights having been used. The specific gravities got this time were these:—

Heavy half, ...	6·4808

The lighter half is now in two pieces:—

The smaller rounded, or lobed portion gave,	6·0050
The larger heavier, or pointed portion of the mass, ...	6·6560
Mean, ...	6·3305

I desire to record the numbers obtained this last time, because, though slightly different from those formerly observed, yet they confirm the somewhat remarkable fact, that the mean specific gravity of this mass of iron is a little less than 6·50, which is, as before mentioned, unusually low, when we consider that it is that of a mass of metal consisting of a preponderating amount of iron, whose density is never less than 7·70, and of a small amount of nickel, whose density is given as not less than 8·80.

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